Actisense™

USB to Serial Gateway

User Manual

USG-1-A-422

For use with NMEA 0183 and IEC 61162-1 connections

Issue 1.01

- Create a safe serial port connection to an NMEA 0183 system that may be on a different power circuit.
- Connect two PCs together that are on different power circuits
- Provide a fully compliant NMEA 0183 port from a USB port
- Receive low level differential signals that are too small to be received directly by a PC serial port

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Important Notices

The **Actisense™** USB to Serial Gateway (USG-1) is intended for use in a marine environment, but only below decks. If the unit is to be used in a more severe environment, such use may be considered misuse under the seller's warranty.

The **Actisense™** USG-1 has been certified to comply with the European directive for Electro-Magnetic Compatibility (EN60945), and is appropriately CE marked. Operation of the unit should be in conjunction with appropriate CE approved shielded connectors and cabling used in accordance with the CE directive EN60945. Any EMC related issues should be reported to Active Research immediately to allow the company to rectify or resolve EMC related problems in accordance with its obligations under EN60945.

If the unit is connected such that compliance failure occurs beyond the company's control, the company shall not be held responsible for compliance failure until suitable EMC guidelines for connection are seen to have been taken.

Notices

When using this document, keep the following in mind:

The products described in this manual and the specifications thereof may be changed without prior notice. To obtain up-to-date information and/or specifications, contact Active Research Limited or visit the **Actisense™ website (www.actisense.com)**.

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Active Research Limited will not be held responsible for any damage to the user that may result from accidents or any other reasons during operation of the user's unit according to this document.

When used on an NMEA 0183 system the USG-1 does not validate the NMEA data it receives in any way. Neither the NMEA sentence checksum, nor the data contained within the NMEA sentence is validated. Therefore, the electronic device(s) supplying the USG-1 with NMEA data retain(s) the sole responsibility for the NMEA data's validity.

Foreword

Actisense™ recognises that instructions are often skipped, so we have aimed to write this document in an informative, yet direct manner that will aid the user. We have tried to cover all the points a typical user may need to know. Please read all sections before installing and using the **Actisense™** USB to Serial Gateway product.

Introduction

The **Actisense™** USB to Serial Gateway (USG-1) product developed out of the requirement to solve three fundamental problems with interfacing the marine industry NMEA 0183 communications standard to a PC.

These are:

1. **Ground loops**. When the PC and the NMEA 0183 system have different ground potentials (or are totally different ground altogether), data can become corrupted and permanent damage can occur.
2. **Different standards**. When you buy a standard USB to serial converter, they normally provide PC standard RS232 port, whereas NMEA 0183 uses a standard called RS422. This results in Incompatible voltage levels and electrical driver types.
3. **PC has no serial port.** Most modern PCs do not come with serial ports any more as these are being replaced by the new standard of USB.

Full information on the complete **Actisense™** product range can be found on the **Actisense™ website**.

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USG-1 solutions

Solution #1 - Ground loops

The first problem encountered when using a standard USB to serial converter (or a standard RS232 port) is that the ground of the PC is then shared with the NMEA 0183 system ground.

PCs are often powered from a mains inverter, generator set or direct from mains supply when in dock, whereas the marine electronics are normally connected to the current marine battery set.

This means that when you connect the two systems together, you are joining two different power systems. This can result in no visible problems, but more often it results in one of three consequences:

1. Data corruption - the data becomes garbled as the electrical data signal now floats on a noisy ground current flowing between the two power systems.
2. The PC crashes intermittently as ground currents flow across its sensitive electronic circuitry. This can cause permanent damage.
3. In the case of large ground loop faults, some components can melt / catch fire / fuses blow or earth leakage devices trip.

The **USG-1** solves all these problems by providing a safe, opto-isolated barrier between the two systems. **Because the signal travels across this barrier as light**, the signals do not share the same ground, and safety is assured as no current can flow between the two power systems. In addition, a built-in power isolator completes the isolation.

Solution #2 - Different standards

PC serial or "COM" ports use the RS232 standard. This uses a ground and a receive pin to get data from a connected system. Data is sent as voltages referenced to ground on a single transmit line. This type of drive is known as "single-ended".

In contrast, NMEA 0183 systems use a "differential" system, where a "Positive" data line and a "Negative" data line move in opposition to each other.

Many installations without isolated outputs have been seen where the negative data line on a differential drive system has been connected to the ground of the PC. If you're lucky, this may work, but if not, you will either simply get no data, or at worst, damage your equipment.

The USG-1 solves this by using ingenious circuitry unique to Actisense in both it's "Listener" (receiver) circuit and its ISO-Drive "Talker" (transmitter) circuit. These circuits are compatible with both RS232 and NMEA 0183 types. Please refer to the **NMEA 0183 Interfacing** section for more information on "Talkers" and "Listeners".

Solution #3 - PC has no serial port

Many laptop and desktop PCs do not come equipped with RS232 type serial ports any more. The USG-1 creates a marine standard NMEA 0183 port from any PC USB port.

This port appears on the PC system as a regular "COM" port, and so can be used with all standard navigation and display software.

Features

Standard USB connection - Equipped with a type "A" USB connector to connect to a USB port or hub (USB v1.1 or v2.0 compliant).

ISO-Drive output technology creates a driver, unique to Actisense, that is isolated to 1500 volts - say goodbye to ground loop issues!

ISO-Drive allows a completely "floating" output to be created, making a safe connection to a PC an easy task. You can use the ISO-Drive output to safely transfer data to an NMEA 0183 device, or to another PC. The output automatically changes between differential and single ended drive depending upon the type of instrument it is connected to.

NMEA 0183 OPTO input - a floating receiver opto-isolated to 2500 volts protects your system even during the most extreme fault conditions.

This differential input is fully compliant with the NMEA 0183 standard specification. This allows the USG-1 to work correctly with long cable runs and in a noisy environment. Typical operating voltage is 2.0v to 15.0v. The unit can withstand +/- 35v continuously, and +/- 40v transients. The input is also compatible with RS232 signal levels.

The Opto-isolator can thus protect any upstream equipment (chart plotter, laptop PC, radar etc.) from up to 2500v of common mode voltage difference.

PC USB drivers supplied on disc - the drivers allow the USG-1 to appear as a standard "COM" port on the PC.

Low current consumption - the USG-1 is powered directly from the USB port on your PC, so no extra power cables are required.

Tough Polycarbonate case - certified to IP54 (Splash and dust proof) when used with both supplied cables.

Software updates

The USG-1 has no built-in firmware, but Actisense will be providing updates to the PC USB drivers free on our website, **www.actisense.com** when they become available.

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NMEA 0183 interfacing

The basics

NMEA data is transmitted from an information source such as GPS, depth sounder, gyro compass etc. These data sending devices are called "**Talkers**".

Equipment receiving this information such as a chart-plotter, radar or NMEA display is called a "**Listener**".

Unfortunately, only one **Talker** can be connected on to a single NMEA 0183 system at any one time. Two or more "**Talkers**" are simply not possible because they are not synchronised to each other, and will attempt to 'talk' at the same time (over each other), resulting in corruption of the NMEA data, and potentially in disaster if valuable data such as navigation information is lost or corrupted so that it is incorrect and/or misleading.

Actisense™ produces a full range of products to solve all NMEA interfacing requirements.

Please visit the **Actisense™ website** for full details on these and other **Actisense™** interfacing products (NMEA Multiplexers, NMEA Buffers, and NMEA Autoswitches), Depth sounders and Sonar products.

The NMEA signals

The NMEA 0183 system v2.0 and later uses a "differential" signalling scheme, whereby two wires are used to transmit the NMEA data. These connections will be labelled as either NMEA "**A**" and "**B**" or NMEA "**+**" and "**-**" respectively, depending on the instrument and manufacturer.

When connecting between different manufacturers, there can be some confusion, but it is simple and easy to remember: NMEA "**A**" connects to NMEA "**+**" and NMEA "**B**" connects to NMEA "**-**".

The different NMEA standards

The NMEA 0183 specification has slowly evolved over the years, so connecting one device to another is not always a straightforward matter. The earlier versions of NMEA 0183 (before v2.0, as detailed above), used slightly different connection methods and signal levels: the instruments had just one "NMEA" data line ('**Tx**' or '**Out**'), and used the ground as the other line - similar to the way a computer serial port works. This connection method is referred to as "single ended" instead of the "differential" method used by NMEA 0183 v2.0 devices.

The data format is largely the same between both systems, with v2.0 adding some extra sentence strings, and removing older (redundant) sentence strings from the specification. The situation is further complicated, as many manufacturers still use the old ("single ended") method of connection because it is cheaper to implement.

The Actisense USG-1 solves all NMEA 0183 connection issues by having inputs and outputs that are totally compliant with both systems and which float independently from ground at all times.

By following the simple connection diagrams in this manual, the user can be safe in the knowledge that as long as the connection is secure, the data will go through as intended and no damage will result.

Please refer to the **Connecting NMEA 0183 devices** and **Connecting Personal Computer RS232 port** sections for example of these connection methods.

Opening the USG-1

The USG-1 comes supplied with a factory installed connection cable with tinned solder wire ends. **Using this cable means that you will not need to open the USG-1 case to make your connections.**

If you need to use your own cable, Phoenix style connectors are provided within the USG-1 to allow you to connect it.

To open the USG-1, remove the two screws in the base of the USG-1, then slide off the top of the USG-1 case. The grommets need to be slid off the top of the case in order to access the internal connections. You will be left with the USG-1 circuitry attached to the base of the unit and the two supplied cables attached to their connectors.

Note: When opening the USG-1 case, be aware that the circuitry inside is not 100% protected against static electricity. Please ensure that, when opening the case, you use precautions against static damage - by only touching the connector block and by holding the unit by its base. In this way, the risks of static damage will be minimised.

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USG-1 connections

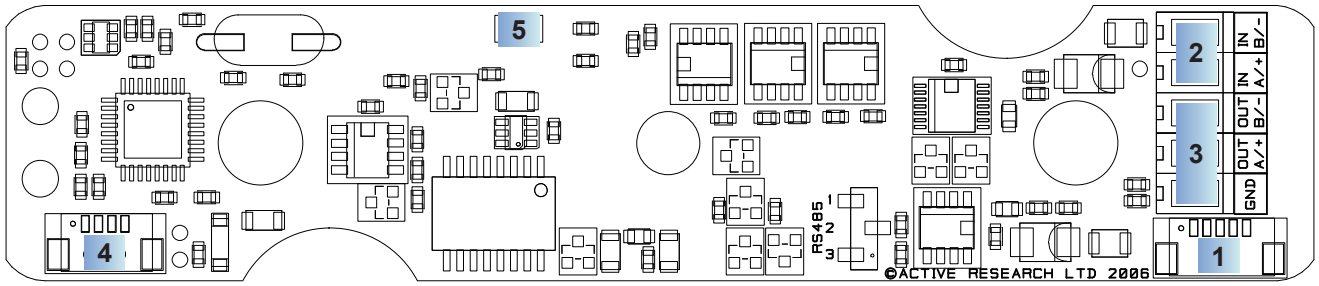


Figure 1 – Inside the USG-1 case

Figure 1 shows an internal view of the USG-1 Printed Circuit Board (PCB). The USG-1 has both micro connectors and screw-terminal "Phoenix" type connectors.

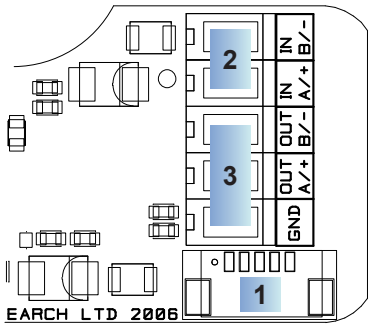
1. **A micro connector attached to the standard data cable that comes with the USG-1.**

   This cable should be sufficient for most installations. The colour codes used for this cable are:

Wire colour	Function
Black	ISO-Drive OUT Ground
Orange	ISO-Drive NMEA OUT B/-
Yellow	ISO-Drive NMEA OUT A/+
Brown	OPTO NMEA Input B/-
Red	OPTO NMEA Input A/+

   This cable also has a screen connection. This is not connected inside the USG-1: in most instances, simply connect this to ground at the instrument end, and this will provide correct screening of the signals on the USG-1 data cable.

   The Phoenix-style connectors are provided for use when the customer needs to use their own cable.



2. **An NMEA 0183 input.**

   Two screw-terminal Phoenix-style connectors are provided to connect the NMEA 0183 input.

   All NMEA 0183 inputs are of the differential Opto-isolated type and use the unique **Actisense™** low current drain circuitry (2mA @ 2.0v) to conform in full with the NMEA 0183 marine electronic device network communication standard. They are also flexible enough to interface to most fully and partially compliant NMEA 0183 devices.

3. **An NMEA 0183 ISO-Drive output.**

   Three screw-terminal Phoenix-style connectors are provided to connect to the NMEA 0183 ISO-Drive output.

   The NMEA 0183 output comprises three connections: '**+**', '**-**' and '**Ground (GND)**' and conforms in full to the NMEA 0183 standard. This allows the USG-1 to interface to various different devices that require any combination of these outputs.

   Note: The connection marked "GND" on the ISO-Drive output is not USB or PC ground, it is connected to the isolated ground of the ISO-Drive circuit. In most installations, this GND should be left disconnected. It is only for use in special circumstances where an "RS485" or "IEC61162-2" 3-terminal type connection is required, and is reserved only for specialist installations. No damage will be caused by connecting to this GND in error, but it may result in missing or corrupted data if it is used. Always follow the connection diagrams shown in this manual to ensure correct operation.

4. **A micro-connector to connect to the supplied USB type A terminated cable.**

   This connector should not normally be removed: it is installed at the factory and is not customer serviceable.

5. **An indicator LED**

   This LED flashes when data is sent from or received by the USG-1. It can be clearly seen through the USG-1's translucent lid when the case is closed.

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Connecting NMEA 0183 devices

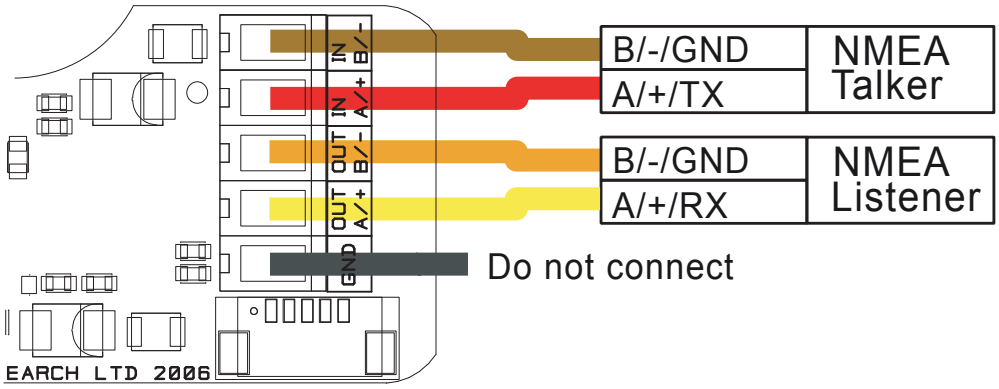

Figure 2 – NMEA 0183 connections

NMEA 0183 Input

The NMEA 0183 differential Opto-isolated input is designed to handle a variety of NMEA 0183 device output specifications. The user must determine (from device manufacturer's information) if the device(s) required to be connected to the **Actisense™** USG-1 conforms in full to the NMEA 0183 network communication standard. If it does not, the flexible **Actisense™** USG-1 inputs should still be capable of interfacing with the device, though this is not guaranteed.

Figure 2 shows a typical installation with an NMEA Talker and an NMEA Listener connected to the USG-1.

The NMEA Talker connections may be marked either A/B or +/- if the talker is a differential drive device, or Tx/GND for a single-ended device.

NMEA 0183 (ISO-Drive) Output

The NMEA 0183 buffered output is capable of driving up to 10 NMEA 0183 fully compliant Listening devices, or a mixture of NMEA 0183 Listening devices and a Personal Computer (PC) communication port.

However it is only recommended to connect one listener to the USG-1. If multiple instruments are connected in parallel to the USG-1, there will be a chance that isolation will not be maintained between them, as some of the connected devices may not have correct opto-isolated inputs.

If the user manuals for the connected instruments indicate that **all** the listeners are opto-isolated, then they may be safely parallel connected into the ISO-Drive output, and safe isolation will be maintained.

The connections on an NMEA Listener may be marked either **A/B** or **+/-** if the Listener is a differential drive device, or **Rx/GND** for a single-ended device. Refer to figure 2.

The ground (**GND**) connection must not be connected.

Notes:

1. To complete the NMEA 0183 standard, all device interconnection NMEA cables used should meet the two-conductor, shielded, twisted pair configuration specification. The shield connection of these wires should be connected at the instrument end only to prevent ground loops.
2. Throughout these connection diagrams, the wire colours represent those actually used on the supplied Actisense USG-1 data cable. When using the supplied cable, simply use the colours indicated to connect to your NMEA 0183 instrument.
3. Refer to the **Specifications** section for the full details on input/output specifications.

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Connecting to a Personal Computer RS232 port

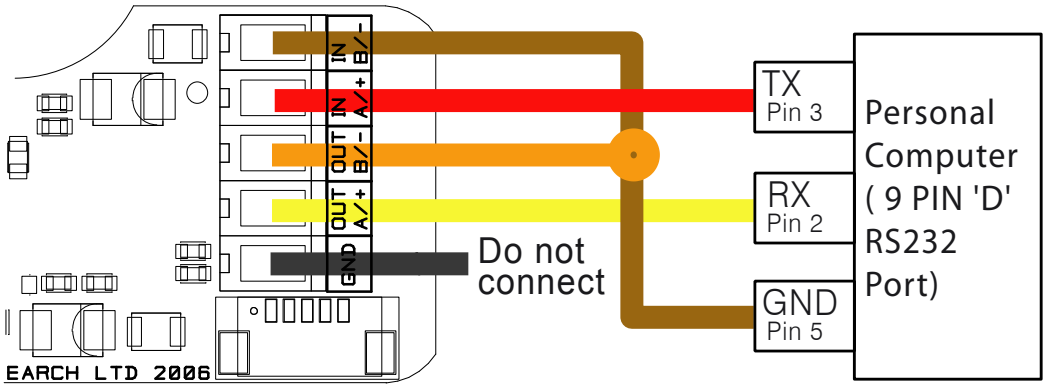

Figure 3 – Personal Computer / RS232 port connections

The USG-1 can be connected to a PC communications port using a cable conforming to the following specification:

1. A D-type female (socket) connector for the PC end of the cable
2. A minimum of 3-cores are required in a shielded cable. Higher quality cable will naturally yield higher performance / higher Signal-to-Noise Ratio (SNR). Most typical cables have two twisted pairs inside. In this case, use one pair for the **TX** line and one for the **RX** line. Use the spare wire in each pair as ground, and connect the cable shield to ground only at the computer end.
3. The **OUT A+** of the USG-1 should be connected to the **RX** of the computer (standard D-type, pin 2) and the USG-1 **IN A+** should be connected to the **TX** of the computer (pin 3).
4. **Connect the IN B- and OUT B- together** and connect to the PC's serial port ground (pin 5).

Connecting to a 3-pin RS485 Listener (IEC 61162-2)

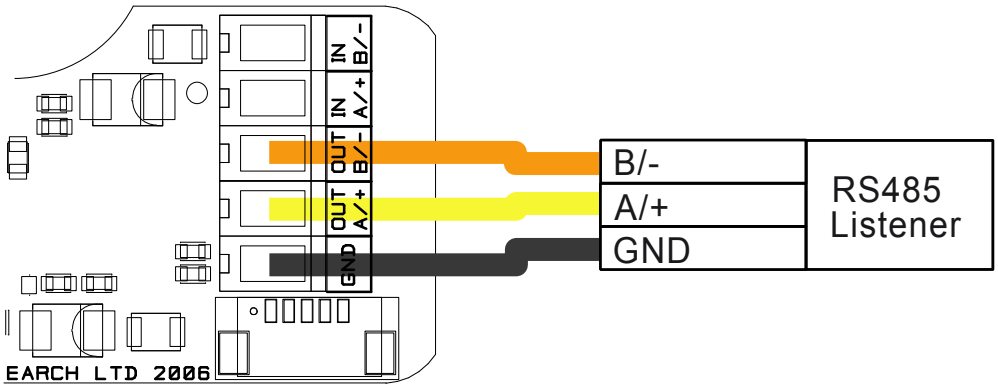

Figure 4 – RS485 / IEC 61162-2 port connections

The USG-1 ISO-Drive output can be connected to an RS485 Listener that requires differential drive plus ground as shown in figure 4.

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USB Driver Installation

The **Actisense™** USG-1 makes use of a virtual serial port driver (know as the Virtual COM Port Driver) to interface between the USB port on the PC and the **Actisense™** product. This driver allows software running on a PC to communicate with the **Actisense™** USG-1 as if it was connected to a standard serial port on the PC, when in fact all communication is done over the USB connection.

The required driver installation comes in two separate packages. The first driver is a called the 'Serial Converter' which converts the USB data packets to a serial data stream. The second driver, called the 'Actisense USB Serial Port', makes the USB connection appear as a COM port in the Windows™ Device Manager.

The USG-1 with USB connection has been extensively tested with both Windows™ XP and Windows™ 98 SE.

For the experienced Windows™ XP user who is used to installing drivers, this section will be very familiar. To all other Windows™ users, the required steps are detailed below to help with installation.

The steps for Windows™ 98 SE are very similar to those of Windows™ XP and so are not detailed here.

The **Actisense™** CD also contains the USB drivers for Windows™ 2000. These drivers have not been tested by **Actisense™**, but should operate in the same manner as the Windows™ 98 SE and XP drivers.

The required Linux drivers are already included in the Linux kernels from v2.4.20 and onwards. However, **Actisense™** has not been able to test the compatibility of the USG-1 with USB and this driver.

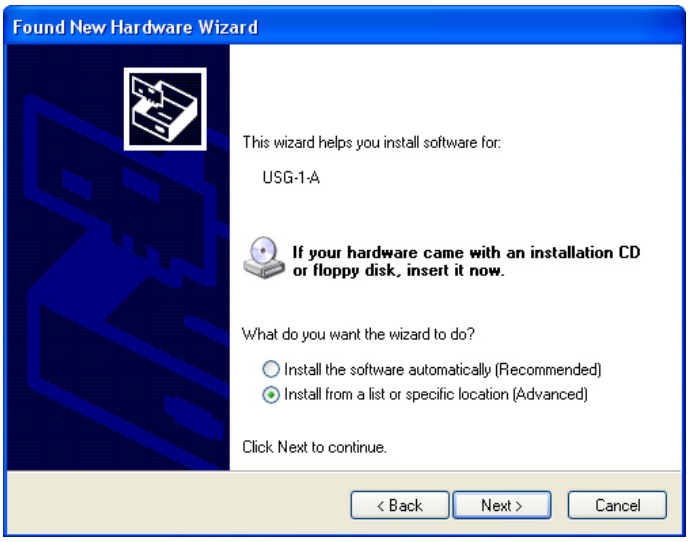
For MAC OS 8, 9, and X please contact **Actisense™** for details (refer to the **Company Information** section).

Step by step guide

1. Make sure the **Actisense™** USG-1 is connected to an available USB port on the PC. The standard Windows™ 'Found New Hardware Wizard' window will then appear.

Select the '**No, not this time**' option, to allow driver installation from the **Actisense™** CD which was supplied with your Actisense product.

2. Insert the **Actisense™** CD, choose the '**Install from a list or specific location**' option, and click '**Next**'.



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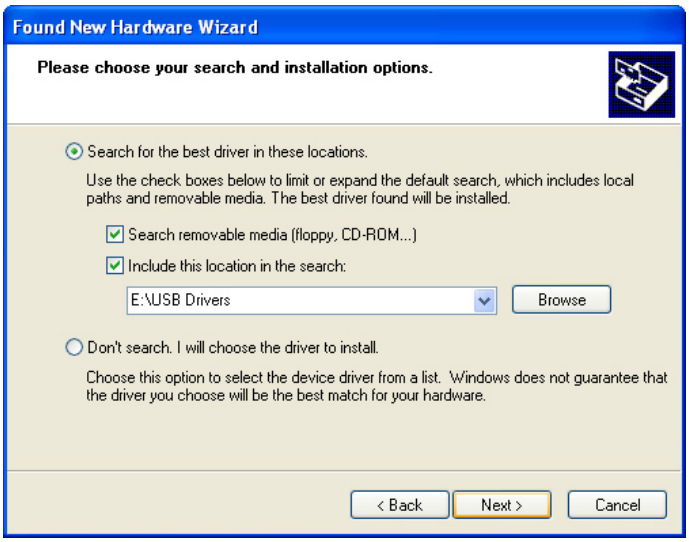
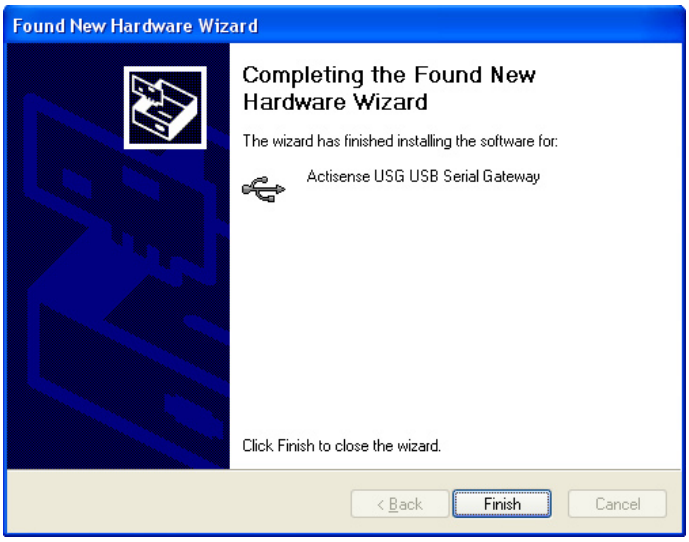
3. Make sure the '**Include this location in the search**' option is ticked, and use the '**Browse**' button to locate the '**USB Drivers**' directory on the **Actisense™** CD.



4. The '**Actisense USB Serial Converter**' driver is not Microsoft Windows™ certified, but it has been 'tried and tested' for stable and reliable operation with the **Actisense™** USG-1. Click '**Continue Anyway**' to carry on with the installation.

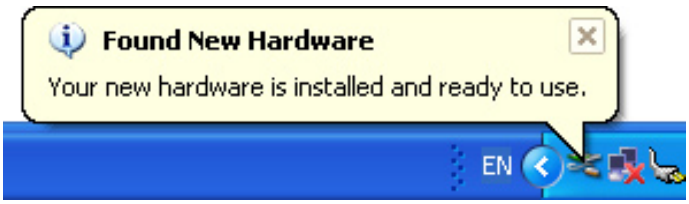
5. The '**USB Serial Converter'** driver is now installed, click '**Finish**' to complete the wizard, and wait for the '**Found New Hardware Wizard**' to appear again.



This second wizard will guide you through the '**USB Serial Port**' driver installation.

6. Follow steps **1** to **5** above for the '**USB Serial Port**' driver installation and click '**Finish**' to complete.

'**Your new hardware is installed and ready to use**' will appear in the bottom right corner of your screen when the installation is complete. See the USB Driver Configuration section for details on how to find out which COM port number has been allocated to your **Actisense™** device as well as how to change to a different COM port and configure the Baud rate.



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USB Configuration

To communicate with the USG-1, the COM port number that Windows™ has allocated to the USB port needs to be determined. The following guide will walk the user through this standard operation.

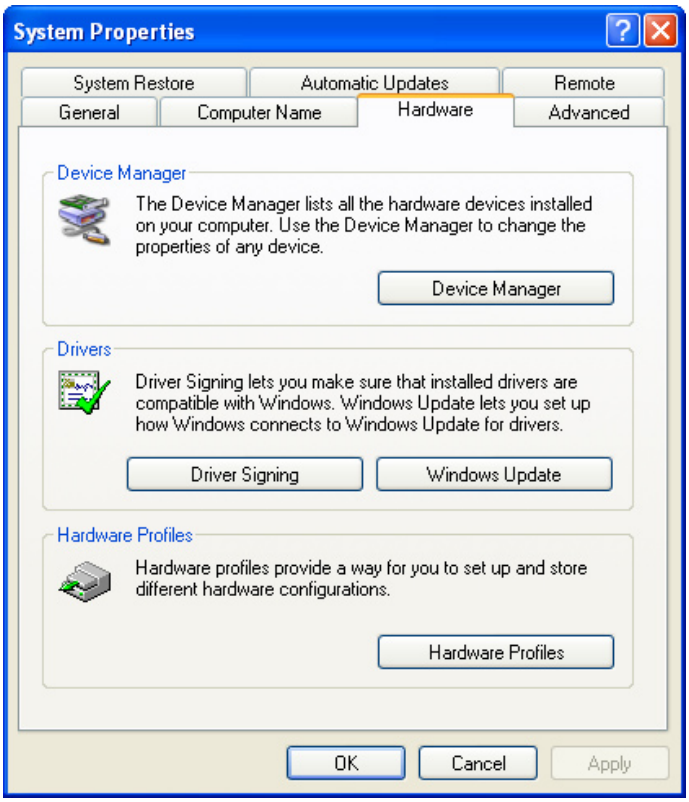
The **Actisense™** USB to Serial Gateway, USG-1 is completely USB port independent: it can be easily unplugged from one USB port and connected to another available USB port on the same PC without the COM Port number changing.

To achieve this independent operation, plug the USG-1 into each required USB port that you require it to work with in turn, install the USB drivers and manually change the allocated COM port number to the same number for each USB port. Once configured, the COM port number will not change unless instructed to do so by the user.

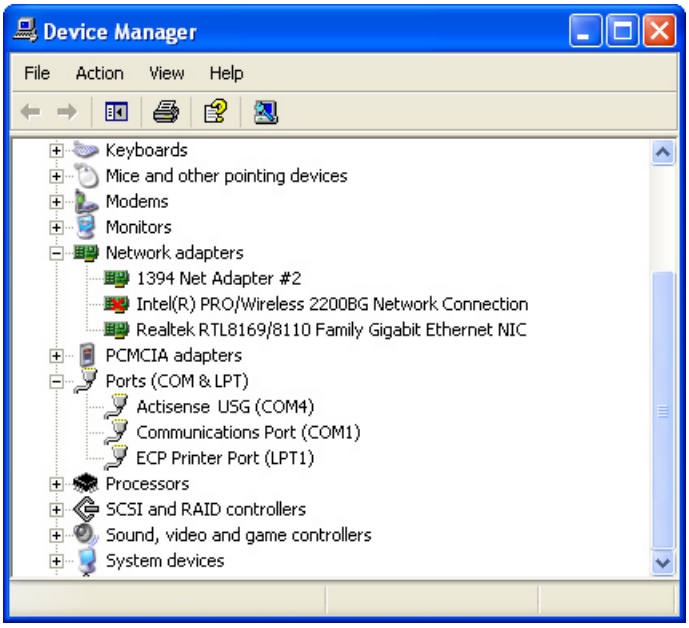
This is very useful when the USG-1 is working in unison with a software program that is set up to use a particular COM port, as the user does not need to reselect a different COM port every time the PC reboots, or the cable is swapped between two USB ports.

Step by step guide

1. Make sure the **Actisense™** USG-1 is connected to an available USB port on the PC. From the Windows™ '**Control Panel**', open the '**System Properties**' window and click on the '**Hardware**' tab.



2. Click on '**Device Manager**' and expand the '**Ports (COM & LPT)**' list by clicking on the '**+**' sign next to it. You will find the '**Actisense USG** in the list, followed by the allocated COM port number.



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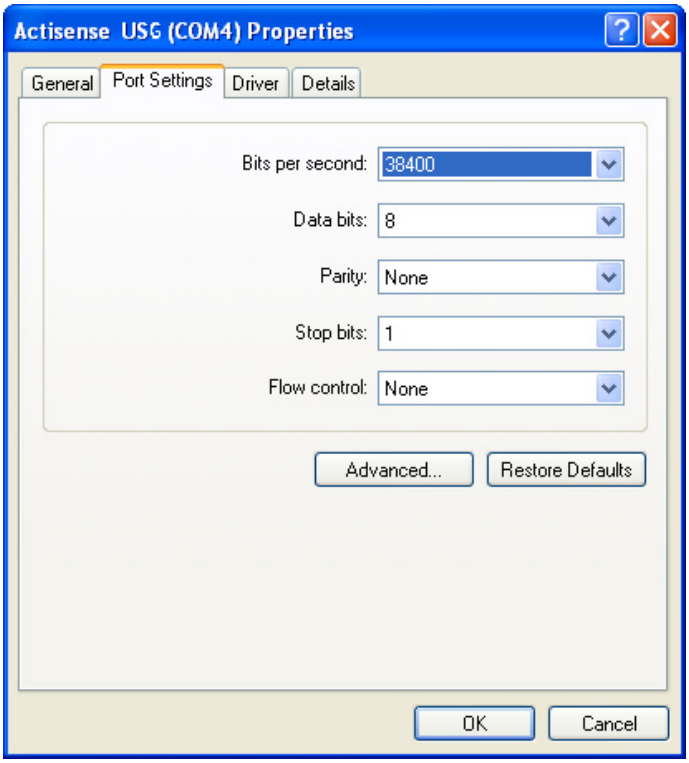
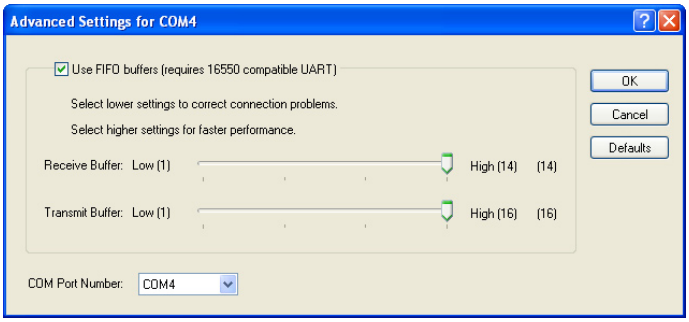
3. Double click on the port icon for the '**Actisense USG**' and the port properties window will appear. Click on the '**Port Settings**' tab. Here you can set the default settings for the USG-1 device. **It is not necessary to change the default settings here - as each software program will define these settings itself.**



4. Click on the '**Advanced**' button and choose a different COM Port number if required (to make it compatible with the software requiring the USG-1 NMEA data).

The other settings are already optimised for the **Actisense™** USG-1 and should be left in the default values. Click on '**OK**' button to save the new settings.



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Troubleshooting guide

This guide will concentrate on all relevant troubleshooting issues above simple cable connection faults. Therefore, the cables between the USG-1 hardware and any other devices should be checked as a matter of course, before continuing with this guide.

Diagnostic LED

The USG-1 hardware has a bright LED that can be seen through the case to indicate when data is **either** received **or** transmitted. It can be used to debug potential problems. If you have both a talker and a listener connected, then you can analyse which is working by disconnecting one of them or by stopping the PC from sending data.

Mode / Error condition	Required user response
LED does not flash when the PC is sending data	Check that the PC program is sending data and that it has opened the comms port assigned (by user) or allocated (by Windows Device Manager) to the USG-1
LED does not flash when the Talker is sending data	Check that the Talker device is correctly connected to the USG-1, that it is powered on, and that it is sending data. **In addition, the USB driver must be correctly installed and the PC software must have the assigned comms port open for the LED to flash**
No data is being received by the Listener, but LED is flashing as PC is sending	Check that the Listener device is correctly connected to the USG-1, that it is powered on, and that it is set to receive data at the Baud rate of the PC comms port. If there is a cable problem that has activated the short-circuit protection, the protective poly-fuses will have activated to protect the USG-1 from damage. In this case, remove the cable fault and wait 1 minute before reconnecting the USG-1 to the NMEA listener device.
	If the error persists, the USG-1 unit should be returned to **Actisense™** (refer to the **Company Information** section). **Please contact Actisense before returning the unit in order to obtain a Returns Number. Any returns sent without a Returns Number will incur a delay in being processed.**

Table 1 – Diagnostic LED colours

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Specifications

The USG-1 ISO-Drive output is a very flexible output that is RS485, RS232, RS422 and NMEA 0183 compatible.

Parameter	Conditions	Min.	Max.	Unit
Supply				
Supply voltage	From USB port	4.75	5.25	V
Supply current drawn from USB port	Supply voltage = 5v (no load)	40	46	mA
	Supply voltage = 5v (output shorted)	75	80	mA
Opto-isolated Flexible Input				
Input voltage between +/-	Logical ‘1’	-15.0	0.5	V
	Logical ‘0’	4.0	15.0	V
Input current	Maximum is under +35v overload condition, min @2.0v input level	2.0	9.0	mA
Differential input voltage	Required level for NMEA to be detected from a connected talker	1.8	2.0	V
Galvanic isolation	Between input & output		2500	V
Overdrive protection			40	V
ISO-Drive Flexible Output				
Output voltage between + and - (under no load)	Logical ‘1’	-4.8	-5.2	V
	Logical ‘0’	4.8	5.2	V
Output current at max load of 100 ohm	At maximum load, differential drive voltage reduces to 2.1v	-	21	mA
Output short circuit current (note 1)	Due to short circuit protection	50	55	mA
Galvanic isolation	From Opto-input and (USB) ground		1500	V
Static discharge protection				
PC Communication settings				
Baud rate	Both input & output Baud rates are set by the PC software settings	300	115200	bps

General				
Ambient temperature		-20	+70	°C

Table 2 – USG-1 specifications

All specifications are taken with reference to an ambient temperature (T_A) of +25°C.

Note:

1. Short circuit may be applied indefinitely. The ISO-Drive output may be short-circuited directly to a 30 volt battery supply without damage. A maximum current of 50mA will flow due to “polyfuse” auto-resetting fuse technology being used in each output.

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Company Information

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